Space Weather Technical Forecast

Issued on Sunday, 23 July 2023 at 01:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1/R2 flares throughout.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Moderate, with only one M3.1 flare originating from AR3372 at 22/0337UTC in the northwest quadrant. AR3372 is one of three large regions on the disc, which combined to represent the majority of the flare risk. AR3373 is a complex region in the west centre disc, with AR3379 in the northeast quadrant. All three of these regions have been relatively stable in both size and complexity over the last 24 hours. There are seven sunspot regions on the visible disc with a number of these weak or simplifying from bipolar to unipolar spots. A further, currently unclassified region on the southeast quadrant is expected to reveal more complexity as it rotates further into view.

A CME as a result of the M3.1 flare has been assessed as missing the Earth. Two further eruptions from the northeast quadrant on 22 Jul will be analysed once sufficient imagery becomes available.

Solar Wind / Geomagnetic Activity: A glancing CME arrival and weak connection to a coronal hole high speed stream, possibly coronal hole 26 have affected the solar wind over the last 24 hours. Speeds fell from 425km/s to 390km/s, but rose due to the high speed stream to around 450km/s. Density started around average, but declined to below average values. Total magnetic field strength reached 10nT, but steadily weakened through the period. The north-south component varied weakly throughout. Phi angle was negative, towards the Sun throughout. Geomagnetic activity has been Quiet to Unsettled.

Energetic Particles / Solar Radiation: GOES-16 proton flux was at background levels. GOES-16 high energy (greater than 2MeV) electron flux was mainly at background. 24-hour integrated fluence followed a declining trend, falling to 2.57e6 integrated pfu by 22/2400UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is forecast to be mainly low with isolated M-class activity.

Solar Wind / Geomagnetic Activity: A CME from 22 Jul has been assessed as missing the Earth. Two further eruptions from the northeast quadrant will be assessed when sufficient imagery becomes available. A high speed stream from coronal hole 27 is forecast to connect with the Earth either late on 23 or during 24 Jul, with speeds around 450-500km/s. Mainly Quiet to Unsettled geomagnetic activity is expected, with a slight chance of Active or G1/Minor Storms either late on 23 or during 24 Jul due to the onset of the high speed stream.

Energetic Particles / Solar Radiation: The high energy (greater than 10MeV) proton flux is now expected to persist at background levels. The high energy electron flux (greater than 2MeV) is expected to be at mainly background levels, with a chance of rising to high at diurnal peak, with this risk greatest later in the period. The associated 24 hour fluence is expected to remain below the active (1e8 total pfu) threshold, but likely rising by the end of the period.

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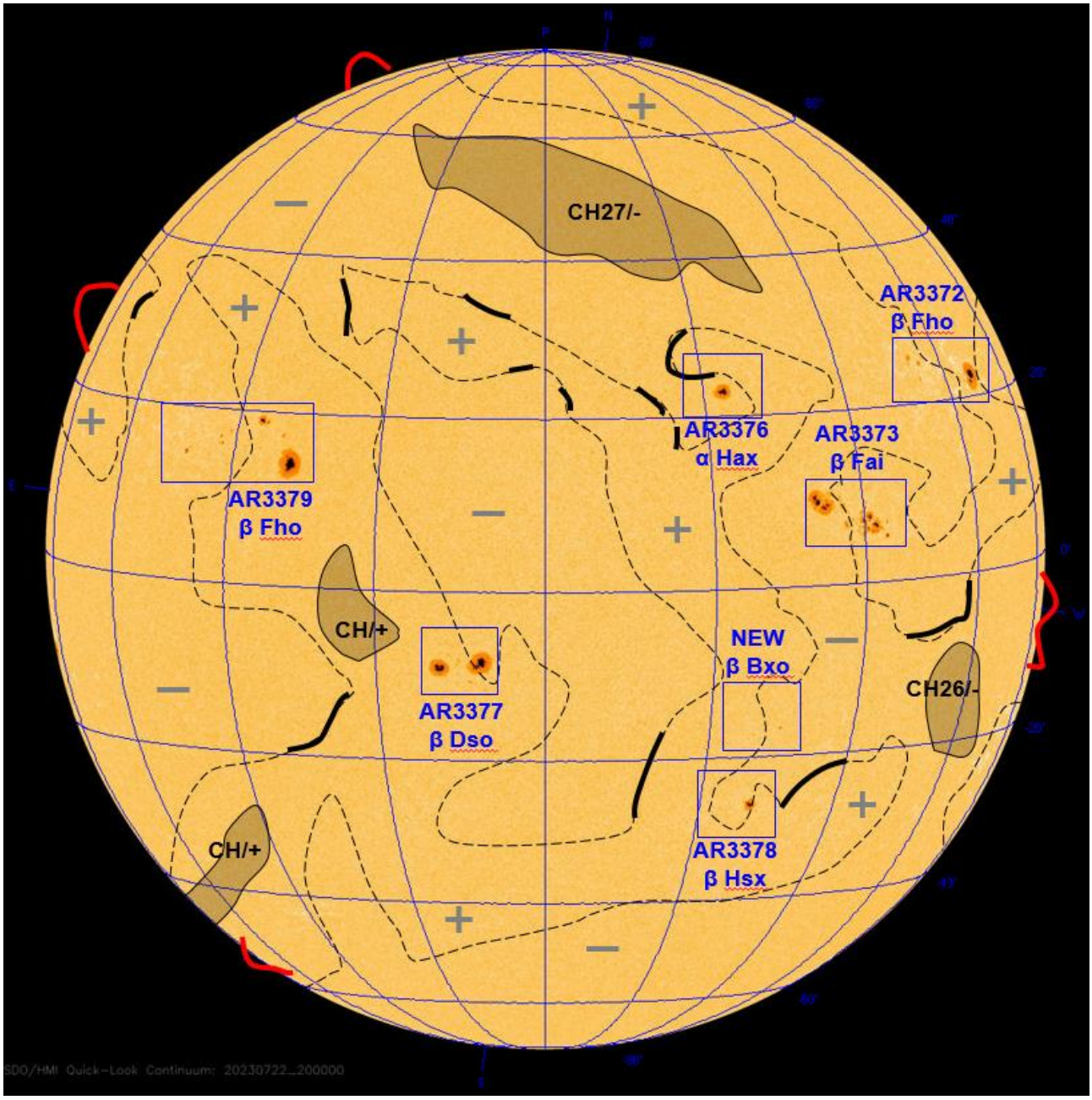
Figure 1. Solar Analysis Valid 22/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

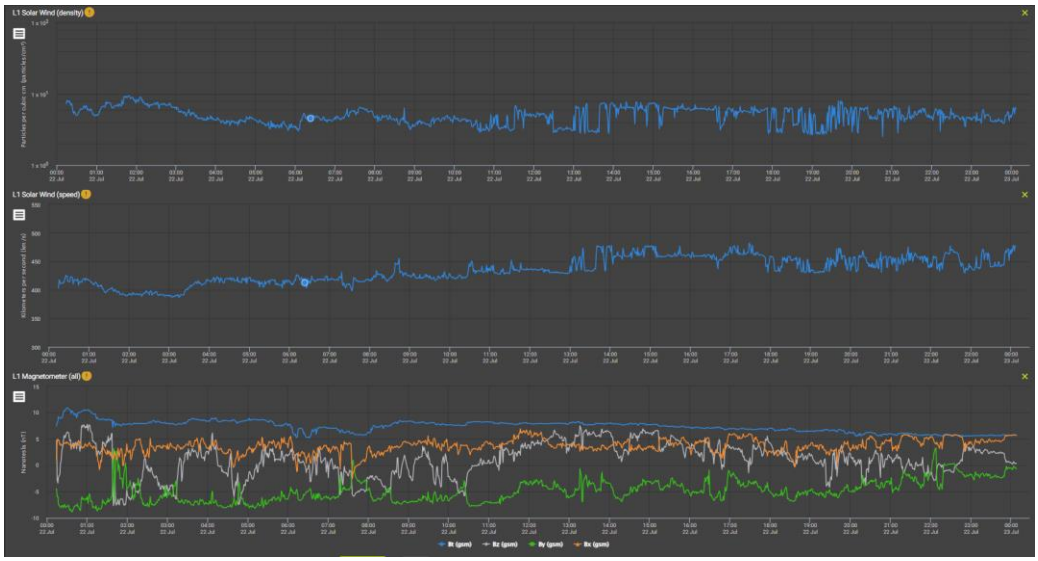
A CME which left the Sun on 22 Jul from the northwest quadrant has been assessed as missing the Earth. Two further eruptions from the northeast quadrant during 22 Jul will be assessed once sufficient imagery becomes available.

Otherwise slightly elevated solar winds may become enhanced either late on 23 or during 24 Jul, due to connection with a high speed stream from coronal hole 27 in the northern hemisphere. This produced speeds of around 500-550km/s on the last rotation but appears to be slightly weaker on this occasion, with speeds of 450-500km/s possible. Winds are then expected to ease through 25 Jul.

Geomagnetic activity is forecast to be mainly Quiet to Unsettled, with a slight chance of Active or G1/Minor storms on 23 or 24 Jul due to the high speed stream connection.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Recent solar wind parameters, showing the increased solar wind and weakening magnetic field strength



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Radio Blackouts - X-Ray Flares:
Solar activity is forecast to be mainly Low to Moderate, with the current main risk from AR3372, which is a complex region in the northwest quadrant, and which has been the sole source of M-class flaring in the last 24 hours. This is one of seven regions on the visible disc, with AR3373 and AR3379 also worthy of note, with both these regions carrying at least a chance of M-class flares. All three of the larger regions appear to have shown limited evolution in the last 24 hours but continue to be monitored.

The remaining regions all appear to have simplified, with a number of bipolar regions simplifying into alpha regions. A new region on the southeast limb, also has the potential to reveal a greater complexity based on analysis of SDO imagery showing magnetic looping.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	Yes	40	40	40	40
Very Active	**R3 to R5 X Class**	No	5	5	5	5

Figure 3: GOES-16 X-ray flux for the last 24 hours.

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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES-16, is now at background level after recent enhancements. There remains a chance of further increases in flux, primarily due to regions on the western hemisphere and any associated flare that these may produce, with an ongoing very slight chance of reaching the S1/Minor Radiation Storm threshold.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electrons (greater than 2MeV) are at mainly background levels in a generally benign solar wind environment. Recent enhancements may have increased electron populations at lower orbits, but the BAS (British Antarctic Survey Radiation Belt Model (BAS-RBM) is not suggesting a significant increase in values at GEO orbit on 23 Jul, with rises later in the period subject to the strength of any high speed stream from the coronal hole connection. The high (1e3pfu) threshold is unlikely to be exceeded until 25 Jul.

24-hour electron fluence is forecast to remain below the Active (1e8 integrated pfu) threshold throughout the period, with no significant inputs expected through the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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